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April 18, 1957

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DOC 7 REV DATE 23/4/80 BY 37169
ORIG COMP 35 OPI 56 TYPE 01
ORIG CLASS S PAGES 21 REV CLASS C
JUST 22 NEXT REV 2010 AUTH: HR 70-2

25X1

Subject: (Miniaturized Data Recorder CB-3
Playback Unit CB-4--Specification No. 57-A-1059-A)

Reference: Bid request dated March 22, 1957

Dear Sir:

Under referenced bid request we have thoroughly reviewed the specifications submitted. It is our conclusion that the task is technically feasible of accomplishment, and our proposal presented herewith contemplates carrying the work through one engineering model of each device.

Our proposal for accomplishing this task is presented herewith in triplicate. You will note that the items listed in Attachment "A" have been identified with a phase of contemplated work.

Phase I - Items 1, 2 & 7
Phase II - Items 3 & 7
Phase III - Items 4 thru 10

Separate phases have been shown to denote our estimate of the natural progression of the work. The nature of costs associated with Phases II and III are very directly related to the outcome of Phase I. We are not in a position to make good cost estimates for the last two phases at this time. Therefore, our cost proposals cover our estimate of the work to be accomplished under Phase I only. In the latter stages of Phase I we expect to furnish a cost estimate of funds required to complete Phases II and III.

We estimate the sum of $137,280.93 will be required to accomplish Phase I, Items 1, 2 & 7, covering a period of twelve (12) months during which we will use our best efforts to design and fabricate a single engineering model per our outline.

Our cost proposal includes a subcontract figure of $27,943.00 to cover work to be done by [redacted]. Details of this work are outlined in [redacted] Proposal 57-649E and the main proposal.

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We wish to convey our great interest in their work, and indicate aspects of our internal research and development which are contributory to the solution of this task.

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Subj: Miniaturized Data Recorder CB-3
Playback Unit CB-4--Specification No. 57-A-1059-A

Page 2--

In the area of miniature synchronous motor development we are currently spending approximately $5,000.00 per month, and have budgeted at this rate for the balance of the year.

Similarly, our interest in miniature frequency standards is being exploited with expenditure in excess of $2,000.00 per month. Budgeting is approved to continue this level of activity for the balance of the year.

Both of these programs have been under way for several years now, and give further evidence of our interest and background.

Other areas under active investigation and of possible application here are the following:

Indium micro-cell battery
Promethium atomic battery
Miniature microphones
Miniature sensitive relays

Since these are more doubtful of application due to technical feasibility or time of availability, we refer to them only in passing.

We would indeed be pleased to be involved in this work, and hope that our enclosed proposed plans meet with your approval.

Very truly yours

[redacted] 25X1

[redacted] 25X1

Enc: Form DD 633 (3 copies)
Cost Estimate (3 copies)
[redacted] Proposal No. 57-649E (3 copies) 25X1
Proposal (3 copies)

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DEPARTMENT OF DEFENSE

COST AND PRICE ANALYSIS

NOTE: If your cost accounting system does not permit analysis of costs as suggested below, contact the purchasing office for further instructions.

Form Approved
Budget Bureau No. 22-R100

NAME OF OFFEROR

HOME OFF

DIVISION(MED

PREVIOUS CONTRACT FOR SIMILAR MATERIAL 25X1

CONTRACT NUMBER

QUANTITY

ACTUAL MANUFACTURING PERIOD (Exclusive PreProduction)

FROM | TO

SUPPLIES AND/OR SERVICES TO BE FURNISHED

Engineering, Development, & Model Mfg. of CB-3 and CB-4 Recording Equipment

QUANTITY	AMOUNT OF PROPOSAL	PROCUREMENT DIRECTIVE NUMBER	PEAK RATE PER MONTH
one each	$137,280.93		

ITEMS (Excluding Tooling) a/	PROPOSED CONTRACT ESTIMATE: PREPRODUCTION	PROPOSED CONTRACT ESTIMATE: PRODUCTION	PROPOSED CONTRACT ESTIMATE: TOTAL	PREVIOUS CONTRACT ACTUAL UNIT COST d/& f/
DIRECT MATERIAL:				
PURCHASED PARTS b/ & material			$ 1,500.00	
SUBCONTRACTED ITEMS b/				
OTHER c/				
2. ENGINEERING LABOR:				
HOURS PREPRODUCTION: 11,100			34,050.00	
3. ENGINEERING BURDEN 81% OF 2			27,580.50	
4. DIRECT MANUFACTURING LABOR:				
HOURS PREPRODUCTION: 3,900			9,750.00	
5. MANUFACTURING BURDEN 58% OF 4			5,655.00	
6. OTHER DIRECT COSTS: j/				
7. Subcontracted engineering services			27,943.00	
8.				
9.				
10. OTHER INDIRECT COSTS: j/				
11.				
12.				
13.				
14. SUB-TOTALS			$106,478.50	
15. SELLING EXPENSES				
16. GENERAL & ADMINISTRATIVE EXPENSES 11.03%			11,744.58	
17. SUB-TOTALS			$118,223.08	
18. PROFIT Fixed Fee - 8%			9,457.85	
19. ROYALTIES e/				
20. CONTINGENCIES g/				
21.				
22. FEDERAL MANUFACTURERS' OR RETAILERS' EXCISE TAX h/				
23. UNIT SELLING PRICE OF TOTAL CONTRACT PRICE EXCLUDING TOOLING i/			$127,680.93	
24. SPECIAL TOOLING COST FROM REVERSE SIDE OF FORM			9,600.00	
25. UNIT SELLING PRICE INCLUDING SPECIAL TOOLING i/			$137,280.93	

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PROPOSAL
MINIATURE RECORDER CB-3
AND
PLAYBACK UNIT CB-4

25X1

FILE 85

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WORK STATEMENT

Design develop and fabricate the items listed in "Attachment A" according to Specification No. 57-A-1059-A, and attached description and sketches. These items to be supplied by a program comprised of three distinct phases as outlined under section titled Delivery Schedule.

Project Organization & Plans

The activities itemized in the Work Statement will be carried out by [redacted] 25X1
[redacted] 25X1

A project engineer, supported by a team of four (4) engineering personnel will direct this work under the guidance of the Engineering Manager, [redacted] Further sub- 25X1
contract support during Phase I will be provided by the [redacted] The subcontract activities will 25X1
be concentrated in the areas of transistorized circuitry, and magnetics design. This work is detailed in attached [redacted] 25X1
proposal No. 57-649E.

In addition to the above, consulting services will be available from the Research Department of the [redacted] 25X1
[redacted] 25X1

Adequate personnel and facilities are available for further support in the area of model making, instrumentation and measurement.

A good base of ideas, techniques and components exists within the present [redacted] organization. Our direct experience covers 25X1
the areas of batteries, microphones, frequency standards, miniature motors, precision gearing, transistorized circuitry, magnetic recording heads as well as general miniaturization techniques. These ideas and techniques will be related to this proposed program by the comments to follow.

Each of these commentaries is referenced to a particular section number in the main specification No. 57-A-1059-A. Only those areas of the specification which are difficult of accomplishment, require elaboration, or are uniquely satisfied by a particular [redacted] technique or product are cited. 25X1

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ATTACHMENT "A"

DELIVERABLE ITEMS

Item 1.	Engineering model, recorder, with accessories	1 each
Item 2.	Engineering model, playback unit	1 each
Item 3.	Prototype model, recorder, with accessories	4 each
Item 4.	Service test model, recorder, with accessories	20 each
Item 5.	Service test model, playback unit	4 each
Item 6.	Kit, accessory, with each recorder consisting of:	25 each

(4) Reels of tape
(1) external microphone
(1) miniature earphone
(1) remote control cable, four feet
(1) carrying case for recorder and accessories
(1) shoulder holster for recorder

Item 7. Bi-Monthly Engineering Progress Report — 5 each

The contractor will prepare and forward to the Contracting Agency each two months, a complete and comprehensive engineering progress report. This report shall outline all experiments, and the results thereof. Schematics, diagrams, sketches, and photographs may be included as required for clarity of description.

Item 8. Final Engineering Report — 10 each

Subsequent to the delivery of Item 4 above, a Final Engineering Report will be prepared which reflects any changes in the Prototype as requested by the Government, and which summarized the results of final tests.

Item 9. Spares, operating, kit, consisting of: — 1 each

5 Recorder electronic unit sets
500% Battery replacement sets with each recorder
600% fuse replacement sets with each play back unit

Item 10. List, parts, for recorder, playback unit — 5 each

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COMMENTARIES

2.2.1 Operating Temperatures

Very fundemental work in lubricants has been carried out and put into practice by [redacted] organization. Availability of LT-71 oil as well as F-50 Versilube lubricants minimizes our apprehension of operating in the + 50°C to - 30°C environment. 25X1

2.2.3. Shock Resistance

Our experience is wide in manufacturing items to withstand the three foot drop onto a hardwood floor. By proper shock mounting, a similar metal cased item, was designed to withstand a five (5) foot drop onto a steel billet. It is anticipated that it will not be possible to keep the inpact from making itself evident on the tape during recording or playback.

2.2.4. Water Resistance

A very recent project of a classified nature as well as heavy commercial experience in water resistant watch cases provides good background for a solution to this requirement. Our commercial cases are designed such as not to leak under one (1) atmosphere of pressure. We have designed reusable cases for extended immersion at depths of eighty (80) feet of water. Attached sketch figure 1.0 shows this Water Resistant Housing in cross section.

2.2.6. Operational Noise

While this particular specification does not appear to be difficult to meet at this time we are prepared to do detailed noise analysis of the equipment. A complete audio test facility including a field-free room, reference microphones, and analysers is available. This facility is part of our microphone design and manufacturing operation recently moved [redacted] from California. 25X1

3.3 Electrical Characteristics

As outlined below the present state of the art is such that achievement of the response characteristics desired is at best difficult. The interpretation that the overall record to playback response is what is specified, will allow emphasis of either the record or playback equipment. The thought here is that any deficiency which can be made up in the larger playback equipment will be capitalized upon.

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A Figure 1.0

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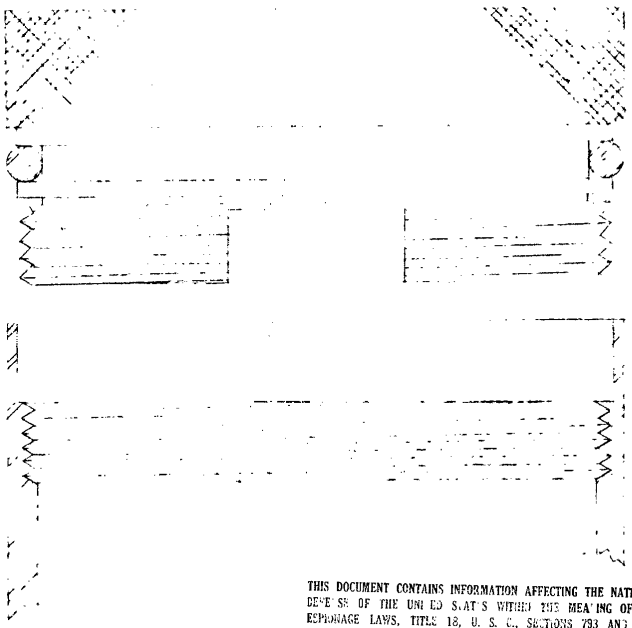

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ITEM NO.	NO. REQ.	DESCRIPTION	DWG. NO.
ITEM NO.		FINISH	NO. REQUIRED
MATERIAL		HEAT TREAT	HARDNESS

25X1

CHGE. LET.	REVISION	DATE	CH'D	APP'D

UNLESS OTHERWISE SPECIFIED
1—REMOVE ALL BURRS AND SHARP CORNERS.
2—TOLERANCES ON MACHINING DIMENSIONS ARE. FRACTIONAL ± .010: DECIMAL ± .003: ANGULAR ± ½°.
3—TOLERANCES ON DRILLED HOLES: WIRE GAGE DRILLS PLUS OR MINUS NEXT DRILL SIZE NOT TO EXCEED PLUS OR MINUS .002. LETTER AND FRACTIONAL DRILLS UP TO ¾ DIA. PLUS .002 MINUS .001. OVER ¾ DIA. PLUS .004 MINUS .002.
4—THREAD LENGTH DIMENSIONS ARE FOR FULL THREADS
5—DO NOT SCALE DRAWING.

TITLE

"O" RING SEAL

SCALE	SHEET NO.	OF	SHEETS
DWG. BY	DATE 4-11-57	DWG. NO.	
CHECKED	DATE	A Figure 1.0	
APP'D.	DATE		

KE ALBANENE 100L TRACING PAPER

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COMMENTARIES

3.3 Electrical Characteristics

An example of such a situation would be to build in a servo mechanism to control the playback tape speed to minimize record speed variation.

3.3.1. Frequency Response

The present state of the art limits the resolution of recording to approximately 1000 - 4000 impressions per inch. A great deal of care and technique must be exercised to achieve this resolution in larger equipment.

Every effort will be made to establish this technique at the size level specified for the CB-3. Particular attention will be paid to the following.

1.0 Gap widths will be reduced to a minimum. One quarter mil (.00025 in.) appears feasible and attempts will be made to achieve one tenth (.0001) mil.

2.0 Extreme cleanliness and finish on tape and head will be maintained. Consideration will be given to polishing techniques for the tape.

3.0 Economy of space in all other areas, electronics batteries, circuitry motors will be exercised such as to allow greatest volume for tape. This increase tape will in turn allow highest tape speed to be utilized without undue shortening of recording time.

3.3.2. Transient Response

All the aforesaid under 3.3.1. will serve to increase the fidelity of transient response. Assuming a maximizing of tape and head relationship the balance of the burden of fidelity rests with the transistorized circuitry and high-frequency permeability characteristics of the recording head. Ferrite materials will be analysed as head magnetics. To compensate for the coarse grain structure, metallic magnetic shoes will be applied in the gap area. This will simultaneously improve wear characteristics.

High frequency transistorized circuitry will be incorporated into the CB-3 of sufficient band width (200 - 300 kc) to give good evidence of the 5 microsecond pulses. It is assumed that uni-polarity pulses are involved.

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3.3.2. Transient Response

The final limit on the capability of recording the 5 micro-second pulse will be determined by the magnetic head gap spacing, and tape speed. If it is not sufficient with the proposed gap space stretching of the pulses will be resorted to. It is assumed that no voice intelligence will appear on the data channels= and for that reason stretching might be tolerable.

3.3.3. Sensitivity

No difficulties are anticipated with the sensitivity specification. The dynamic range of 25 db appears attainable with either AC or DC bias. The benefits of DC bias, no radiation, simplified circuitry, will be analysed and compared with minimum noise and greater dynamic range of AC bias.

An integrated facility is at hand to maximize the microphone design. An analysis will be made at the start of our design to choose a barium titanate or magnetic pick up device.

3.3.4. Distortion

Some interpretation is necessary regards the comment of "15 per cent distortion on any channel". We presume from the band widths involved that this specification should relate only to the voice channel.

3.3.5. Speed Variation

We are proposing to utilize the electro-mechanical oscillator as the prime source for all AC voltage in this device. The electro-mechanical oscillator is a recent [redacted] development and is shown in attached sheet, figure 2.0. With adequate transistorized circuitry and a synchronous motor drive on the capstan assembly the 2% flutter and wow should pose no great problem. This will assist but not necessarily eliminate that component of flutter which is friction excited. 25X1

3.3.6. Recording Time

As indicated under sections 3.3.1. and 3.3.3. and the [redacted] proposal the fidelity is directly related to tape speed. Present indications are that some portion of the 60 minute recording capacity will be reduced. Several novel schemes of wind and unwind on a common spool occur to us and these will be explored in the design procedure. A good efficiency of space along with ease of magazine feeding would result. 25X1

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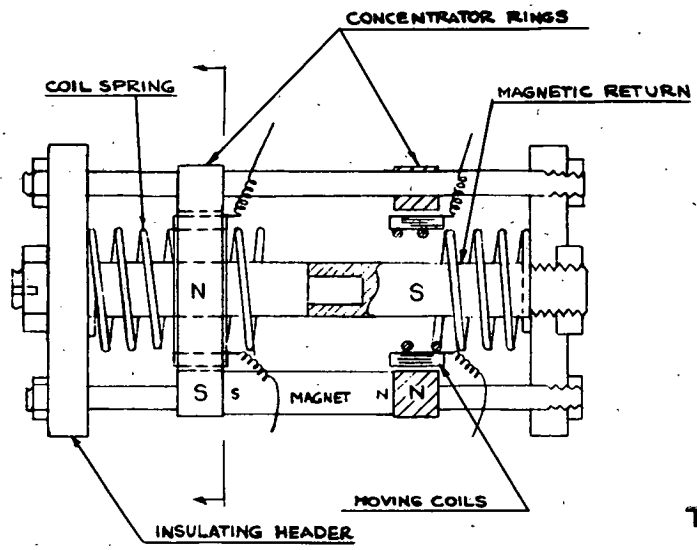
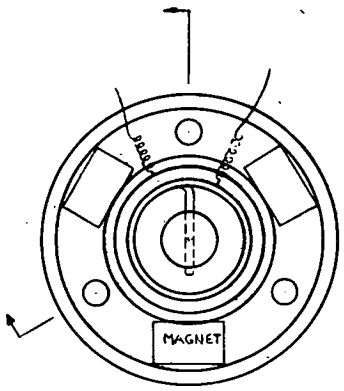
Figure 2.0

STAT

Electro-Mechanical Oscillator





TYPE E-100

The Electro-Mechanical Oscillator as shown in the above figure is a device capable of being used as a frequency standard or frequency selecting device in frequency ranges heretofore unattainable with simplicity and accuracy.

Some of the more apparent advantages of this device are that it is **lightweight, compact, portable,** operates in the microwatt range of power, and combines rugged construction with performance characteristics comparable to high quality tuning forks.

Another equally valuable advantage is that it may be operated with a simple, single transistor circuit which provides undistorted sine wave output and self-starting operation.

Upon examining the sketch of the Electro-Mechanical Oscillator, it will be seen that the unit consists of a helically wound coil spring held at each end by a rigid structure. Mounted solidly on the spring at vibration antinodes are two coils of fine wire which move in a radial magnetic field generated by the surrounding magnetic structure.

One coil of wire serves as the drive coil and causes the spring to vibrate in its second mode as a signal of proper frequency is fed into the coil. The driving force is obtained through the interaction of the coil field and the fixed field. The resultant movement of the other coil or output section in the fixed magnetic field feeds a portion of the signal generated in it back to the drive coil through an amplifying circuit. At a certain magnitude the oscillations become self-sustaining at a frequency which corresponds to the second mode resonant frequency of the coil spring.

It is anticipated that the cost of this unit will be comparable to and probably lower than similar frequency sensitive devices.

See other side for specifications.

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Figure 2.0

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Tentative Specifications—Type E-100

A. Oscillation in the 100 to 1500 cycles per second range.

At the present time oscillators are being built in 200-400 cycle range using only slight modifications from one basic design to achieve this range. Indications are that higher and lower frequencies can be easily obtained with some redesign.

B. Size, depending upon application, from 1/32 to 1 cubic inch.

The oscillator may be hermetically sealed and provided with standard tube bases for plug-in applications or simple brackets for printed circuit board mounting.

C. Weight range from 1/10 ounce to 1 ounce.

Original models have been sealed in metallic cans. It will be possible to incorporate shock mountings in the assembly and vibration isolation mountings to protect the oscillator from external vibrations. Since the oscillator vibrates in the second mode, energy is not transferred to the mounting from the oscillator itself due to the cancellation of forces within the vibrating spring.

D. Position error, 1 part in 100,000 in any position.

E. Amplitude error.

Frequency change with change in amplitude of vibration can be expected to be less than 1 part per 100,000 when the device is used in circuitry such as customarily employed with tuning fork oscillators.

F. Temperature error .5 part in 100,000 per degree Fahrenheit over a range of 40°F to 100°F.

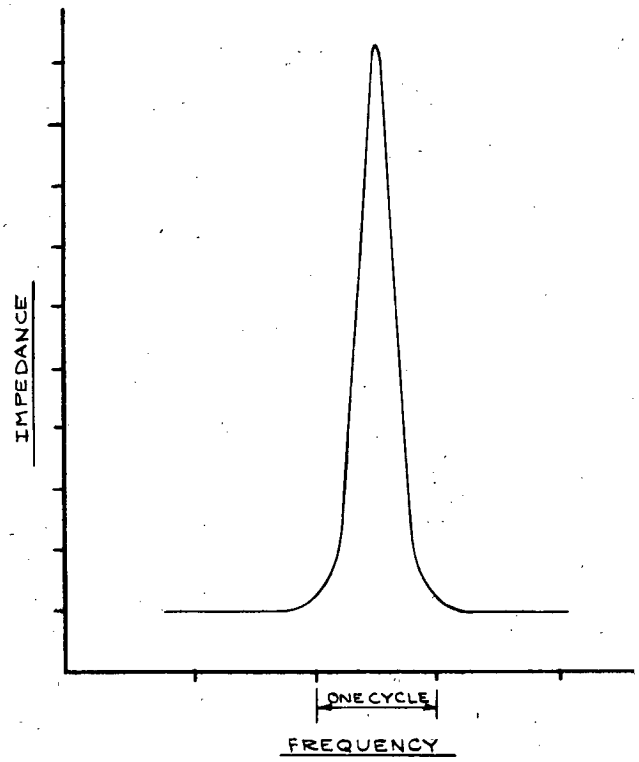
In the range of 0°F to 150°F, the temperature error is about 2 parts in 100,000 per degree Fahrenheit.

G. Selectivity—10 to 1

When the Electro-Mechanical Oscillator is operating as a frequency sensing device the impedance at the resonant frequency is 10 times that at non resonant frequencies. The Q of the device, as determined from the accompanying frequency response curve, is greater than 1500.

H. Power requirements—about 10 microwatts

At 10 microwatts, a median amplitude of vibration, suitable for most applications, can be obtained.



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3.3.6. Recording Time

We are purposely avoiding the "Study Phase" approach or any fundamental investigation of any alternate recording techniques. While we are prepared to carry on such a program we do not understand this to be the aim of this bid request. More specifically we understand the task to be one of engineering the best device attainable using the most advanced techniques available.

3.3.7. Recording Medium

There have been indications in some preliminary investigations that neither 1/4 mil or 1/2 mil tape is suitable for high quality recording. Note attached letter regards [redacted] tape. The implication is that 1 mil mylar tape will be required. This will work a further hardship on the recording time interval. We would like to offer the thought that we explore the use of 1/2 or 1/4 mil tape on a one-shot use basis, thus avoiding "working" of the dimensions or surface. 25X1

The possibilities of lubrication and polishing to 15 - 20 microinch will be investigated to make usable these thin tapes. This will also assist in reducing the flutter induced by friction excitation.

3.3.8. Recording Head

It is assumed that a staggering of the heads lengthwise along the tape to achieve the 0.100 head spacing is allowable. Actually we expect to be able to put three heads next to each other. A sketch, figure 3.0, of a magnetic head developed and manufactured by [redacted] is attached. 25X1

A great deal of mechanical precision is required here to achieve even average results. We anticipate a good portion of the expenditures to be centered on this work. We have alloted a share of the tooling expense itemized in our cost estimate for this work.

Ferrite materials along with a fine grain magnetic shoe will be tried in the first design. Alfenol metal laminations will also be investigated.

While it is possible to roll metals to a thickness (.0001 inches) suitable for gap spacer, it is difficult. As an alternate we are prepared to vapor deposit metals onto the base material and thus control the gap spacing.

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25X1

February 26, 1957

25X1

Thank you for your interest in [redacted] Instrumentation Tape. [redacted] manufactures instrumentation tape in 1 1/2 mil Mylar and acetate and 1-mil Mylar. We do not think it feasible to make half-mil Mylar tape and for that reason we do not recommend it. To our knowledge no other manufactures make a tape of instrumentation quality on half-mil Mylar. Enclosed is information and price list on [redacted] Instrumentation Tape.

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25X1
25X1

May we suggest that you write or phone our chief electronic engineer, [redacted] or our research director, [redacted] about your specific instrumentation problem.

25X1
25X1

25X1

Sincerely,

(signed)

[redacted]

Vice President, Sales

25X1

NW/esp
Encl.

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A Figure 3.0

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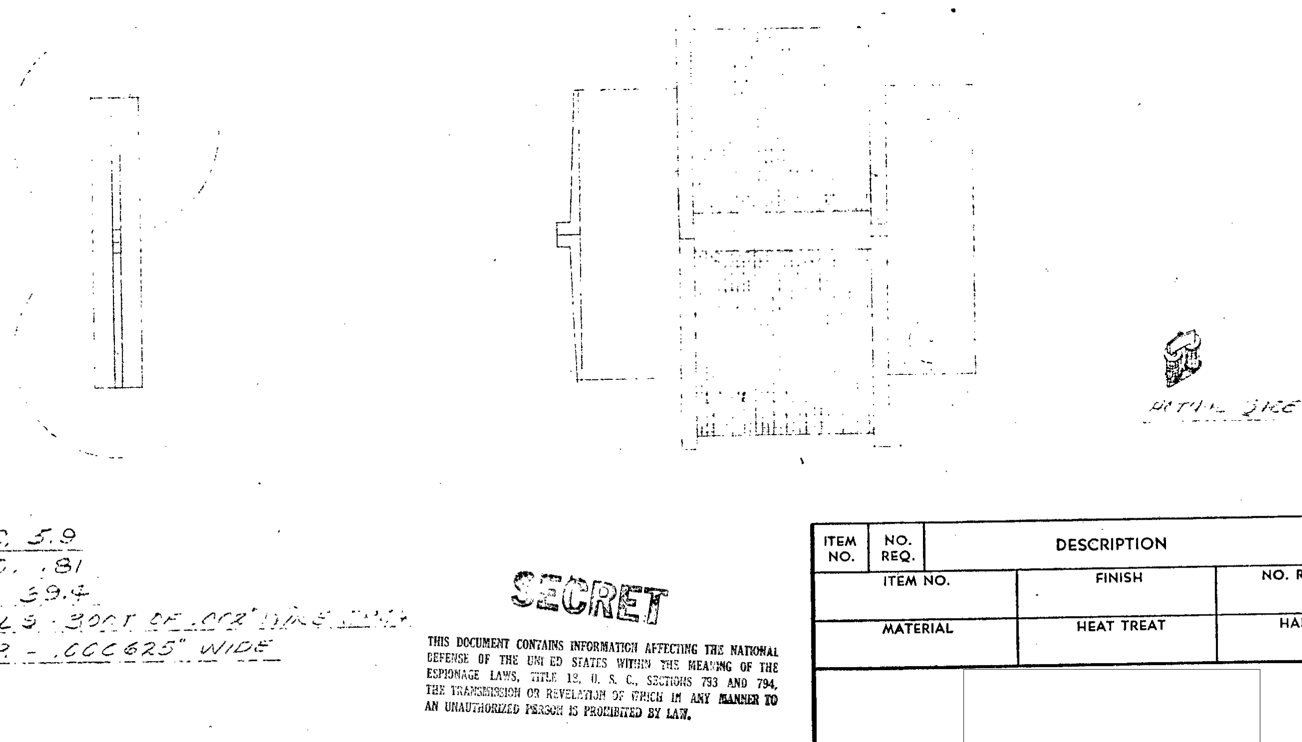

IND. 5.9
D.C. .81
R. 39.4
COILS: 300T OF .002" WIRE [illegible]
GAP - .000625" WIDE

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ITEM NO.	NO. REQ.	DESCRIPTION	DWG. NO.

ITEM NO.	FINISH	NO. REQUIRED
MATERIAL	HEAT TREAT	HARDNESS

[redacted] 25X1

CHGE. LET.	REVISION	DATE	CH'D	APP'D

UNLESS OTHERWISE SPECIFIED
1—REMOVE ALL BURRS AND SHARP CORNERS.
2—TOLERANCES ON MACHINING DIMENSIONS ARE. FRACTIONAL ± .010: DECIMAL ± .003: ANGULAR ± ½°.
3—TOLERANCES ON DRILLED HOLES; WIRE GAGE DRILLS PLUS OR MINUS NEXT DRILL SIZE NOT TO EXCEED PLUS OR MINUS .002. LETTER AND FRACTIONAL DRILLS UP TO ¾ DIA. PLUS .002 MINUS .001. OVER ¾ DIA. PLUS .004 MINUS .002.
4—THREAD LENGTH DIMENSIONS ARE FOR FULL THREADS
5—DO NOT SCALE DRAWING.

TITLE MAGNETIC RECORDING HEAD

SCALE 10:1	SHEET NO.	OF	SHEETS
DWG. BY [illegible]	DATE 4-9-59	DWG. NO.	
CHECKED	DATE	A Figure 3.0	
APP'D.	DATE		

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4.2. Battery Life

We anticipate utilizing standard commercial cells to power the CB-3. If a need should develop for a specialized cell to achieve better efficiency of energy storage we would consider fabricating our own. This is costly by comparison with commercially available cells however, and will not be resorted to without lengthy discussion with technical monitor.

We would like to offer the thought that a micro-watt battery life indicator be designed into this equipment. Since this was not a part of the specifications we leave it as a suggestion only.

5.1. Limiting Volume Factors

It is recognized that the geometry and dimensions are fixed at this time. No diviations shall be made without prior approval of the technical monitor.

Initial thinking of the probable location of some components is shown in attached sketch, figure 5.0.

5.6. Transport Motor

It is anticipated that the utilization of the synchronous motor drive will solve three major problems in the tape transport. First, speed variation resulting from battery voltage fluctuation will be eliminated. Second, a mechanical speed govenor will no longer be required. And third, the radiation problem, both electric and magnetic, will be largely eliminated.

Available commercial synchronous motors are much too large and inefficient for application here. Considerable theoretical and model work has been done by Elgin to achieve a truly synchronous motor at the 10 micro-watt level. We know that higher power motors will be required and suggest that it will be quicker arriving at a useable motor because of this background work.

A sketch, figure 4.0, of one such micro-watt motor is attached.

Present design activities in this area are to be maintained [redacted] at the level of $2500.00 to $3000.00 per month. Any applicable results of this work will be made available to this project. 25X1

A major requirement of the transport scheme is that it holdsthe tape in close proximity to the head. Good precision mechanics will be required to maintain this spacing to less than the gap width of .00025 inches. The benefits available in this area are realized (loss = 55 db times ratio spacing/wave length) and emphasis will be placed on proper design.

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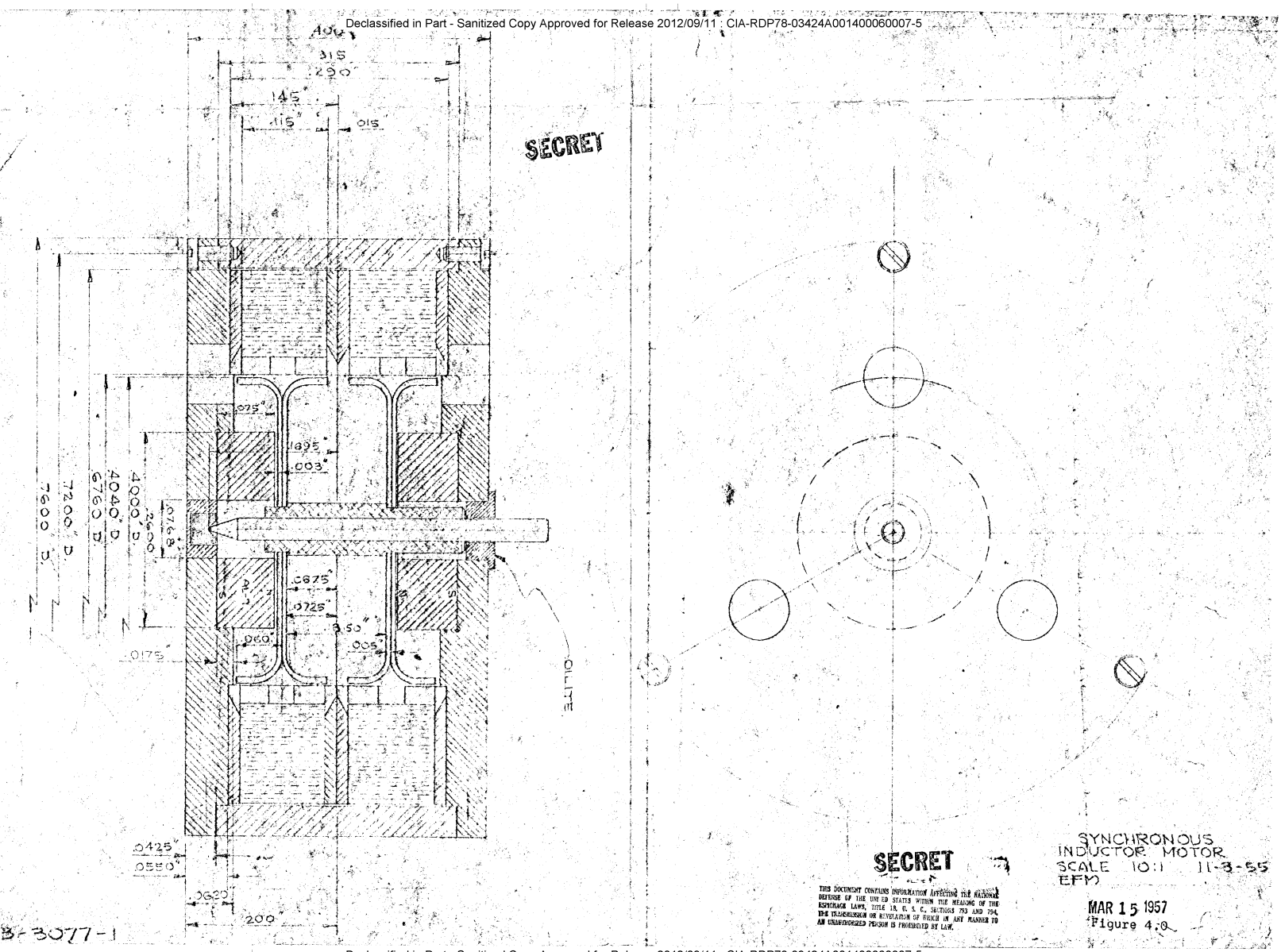

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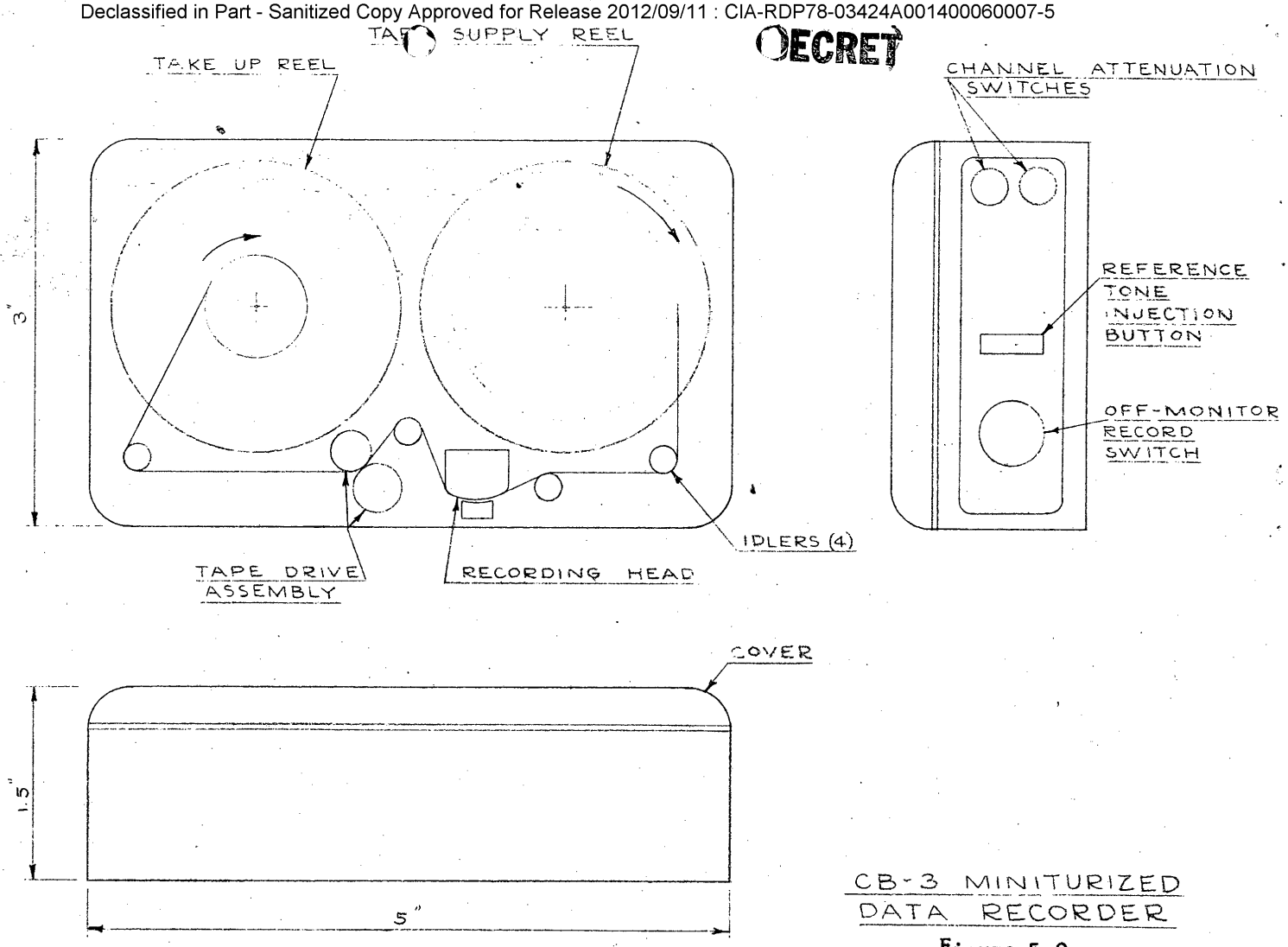

CB-3 MINITURIZED DATA RECORDER

Figure 5.0

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Delivery Schedule

Items shown on Attachment "A" will be delivered as follows:

Phase I: The engineering, design and fabrication of Items 1 and 2 will be completed in the twelve (12) month period following date of contract. Engineering Progress Reports, Item 7, will be supplied bi-monthly during this phase.

Phase II: Final orientation of components, engineering and fabrication of four (4) Prototype model recorders, with accessories, Item 3 will be completed six (6) months following completion of Phase I. Item 7 will continue to be delivered during this phase.

Phase III: The balance of items of Attachment "A" namely:

Item 4. Service test model, recorder, with accessories — 20 each

Item 5. Service test model, playback unit — 4 each

Item 6. Kit, accessory, with each recorder consisting of: — 25 each

(4) reels of tape
(1) external microphone
(1) miniature earphone
(1) remote control cable, four feet
(1) carrying case for recorder and accessories
(1) shoulder holster for recorder

Item 7. Bi-Monthly Engineering Progress Report — 5 each

The contractor will prepare and forward to the Contracting Agency each two months, a complete and comprehensive engineering progress report. This report shall outline all experiments, and the results thereof. Schematics, diagrams sketches, and photographs may be included as required for clarity of description.

Item 8. Final Engineering Report — 10 each

Subsequent to the delivery of Item 4 above, a Final Engineering Report will be prepared which reflects any changes in the Prototype as requested by the Government, and which summarized the results of final tests.

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Item 9. Spares, operating, kit, consisting of: 1 each

5 Recorder electronic unit sets
500% Battery replacement sets with each recorder
600% fuse replacement sets with each play back unit

Item 10. List, parts, for recorder, playback unit 5 each

Items 4 through 10 will be delivered during the six (6) month period following completion of Phase II.

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COST ESTIMATE

MINIATURE CB-3 RECORDER
and
CB-4 PLAYBACK UNIT

Purchased Parts		$1,500.00
Subcontractor Costs		27,943.00
Project Engineering Labor	2100 hrs. @ $4.75	9,975.00
Design Engineering Labor	2100 hrs. @ $3.25	6,825.00
Drafting Labor	3000 hrs. @ $2.50	7,500.00
Technician Labor	3900 hrs. @ $2.50	9,750.00
Burden	81% of $34,050.00	27,580.50
Machine Labor	3900 hrs. @ $2.50	9,750.00
Machine Labor Burden 58%		5,655.00
	TOTAL FACTORY COST	$106,478.50
G. & A.	11.03%	11,744.58
	TOTAL COST	$118,223.08
Fixed Fee	8%	9,457.85
	SELLING PRICE	$127,680.93
Special Tooling		9,600.00
	TOTAL SELLING PRICE & TOOLING	$137,280.93

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MINIATURE CB-3 RECORDER
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Project Engineering Labor	2100 hrs. @ $4.75	9,975.00
Design Engineering Labor	2100 hrs. @ $3.25	6,825.00
Drafting Labor	3000 hrs. @ $2.50	7,500.00
Technician Labor	3900 hrs. @ $2.50	9,750.00
Burden	81% of $34,050.00	27,580.50
Machine Labor	3900 hrs. @ $2.50	9,750.00
Machine Labor Burden 58%		5,655.00
	TOTAL FACTORY COST	$106,478.50
G. & A.	11.03%	11,744.58
	TOTAL COST	$118,223.08
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	SELLING PRICE	$127,680.93
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